



COMPUTER DYNAMICS INCORPORATED

Subject: "Portalog 600A" and
"IPAC" Series Analog Simulators

Dear Mr. Nelson:

Thank you for your inquiry concerning the Computer Dynamics Portalog 600A and the IPAC series of analog simulators. The use of analog techniques for simulation of processes and control problems is now highly regarded as an economical and time-saving method for designing system and control system variables. Computer Dynamics Specification 200 describes modular hardware of advanced design for economically setting up electronic simulation of control and system problems. The simulator may be packaged as a ten-amplifier portable unit (Portalog 600A), weighing less than thirty pounds, or as a desk top simulator with a removable programming patch bay.

The photographs shown on the back of our Specification 140 data sheet, which is attached to Specification 200, show two units with a patch bay in between. This model has a capacity of 28 amplifiers. However, there is nothing to limit the expansion of this system to as many amplifiers as needed. For example, a hundred amplifier system would be mounted in a standard rack with a somewhat larger patch panel. The patch panel used is a standard IBM type which is highly reliable and very economical. The patch panel shown with 680 holes is furnished by Computer Dynamics for \$50.00 each and can be obtained without screening for \$25.00 each.

The Computer Dynamics design permits the user to program his problem directly on the front of the amplifiers and programming units such as the 323 summer-integrator and also from the patch bay. The patch bay does not cover the computing components as is done in some other designs. Thus, the components may be removed without disturbing the patch bay.

The same components used in the laboratory to simulate process dynamics can be used to make on-line analog process controls by repackaging in your own system.

Computer Dynamics will be publishing an operations manual for the use of the simulators described in Specification 200, together with other applications notes on the use of operational amplifiers for control processes. Please fill out the enclosed return inquiry card if you wish to be kept up-to-date on these developments.

Sincerely yours,

John M. Embree
Director of Sales and Applications Engineering

Enclosures

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DC AMPLIFIERS AND
ANALOG PROCESS SIMULATORS



COMPUTER
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SPECIFICATION NO. 200
PORTALOG COMPACT COMPUTERS
and
IPAC DESK-TOP CONSOLE COMPUTERS

PORTALOG COMPACT COMPUTERS

The Portalog Compact Computer is a fully transistorized, portable (weight about 30 pounds) compact analog computer designed for convenience of transportation and use. It may be hand-carried anywhere in its rugged, rain-proof aluminum attache case, and is ready to operate immediately after connection to any standard 117 volt 50/60 cycle AC outlet. (Also available for 230 volts/50 cycles). It is designed for setup in the field or at the test stand to simulate controls or dynamics of chemical, electrical, electronic, pneumatic, mechanical, or hydraulic systems or processes. It may also be removed from its case and mounted in a standard relay rack of 19" width. It may be expanded or operated in tandem with other computers to simulate larger systems. The amplifiers may also be used conveniently as part of special instrumentation and measurement setups instead of as a computer.

The programming of the computer is on a conventional basis, although special programming for mechanical engineers, chemical engineers and other special groups can be provided. It has all the control features of much larger computers, making it an ideal unit for instruction in the principles and applications of analog computers.

A major feature is a new "Graph-Plot" mode of operation furnishing data in a most convenient form for recording problem solutions on graph paper and making unnecessary the use of any external recorder with the computer. Points are simply read off on the built-in meter at regular periodic intervals and are identified by an automatic counter. This feature is also desirable in making consecutive programmed measurements of devices or instruments.

No external plug-in resistors or capacitors are required to program the computer. Amplifier inputs and outputs are available so that special functions can be set up by means of patch cords. Input resistors and feedback resistors and capacitors are mounted internally. Feedback resistors and capacitors are selected simply by means of switches. All attenuators may be monitored without disturbing the patching by means of push-button switches which connect them to a "Pot Bus" which can be either read out on the meter or nulled against a precise reference potentiometer.

STANDARD AND SPECIAL COMPONENTS OF THE PORTALOG

The Portalog is expandable as a general purpose computer in several options from six to ten amplifiers. The computer is assembled entirely from components of the "IPAC System" by Computer Dynamics, Incorporated. "IPAC System" stands for "Industrial Process Analytical Computer System". This defines a class of systems assembled using standard, interchangeable IPAC modules to make general purpose analog computers, process control computer systems, dc amplifier systems, and truly portable computers.

resistor or capacitor switched internally across the amplifier. The IC jack is patched to either the plus reference or the minus reference to set an initial condition on the integrator. The resistors in the 323 panel are 0.5% and the capacitors are 1% mylar film. The IC pot is a single turn pot. Contains all relays necessary for mode control switching of the associated amplifier.

- 323-P Precision Integrator-Summer Module - same as 323 except with 0.05% precision resistors, a 1% polyparaxylylene capacitor in switch position #1, matched to 0.1% with input resistors and a ten-turn precision wire-wound pot and turns-counting dial for setting initial conditions.
- 324 Reference, Diode, and Tie Point Panel - contains two jacks for minus reference voltage, two jacks for positive reference voltage, two diodes with two jacks at each end, and two three-jack tie points for patching common connections.
- 312 Tie Point Panel - contains a six-jack tie point for patching common connections.
- 313 Dual Function Switch Panel - contains two single-pole double throw switches with jacks for all connections.
- 310 Blank Panel, $3\frac{1}{2}$ " high x 1" wide
- 310-E Blank Panel with rearward extrusion for mounting components.
- 320 Blank Panel, $3\frac{1}{2}$ " high x 2" wide
- 320=E Blank Panel with rearward extrusion for mounting components.
- 3F3 Filler Panel, R.H. Side, $3\frac{1}{2}$ " high
- 510 Blank Panel, $5\frac{1}{4}$ " high x 1" high
- 510-E Blank Panel with rearward extrusion for mounting components.
- 520 Blank Panel, $5\frac{1}{4}$ " high x 2" wide
- 520=E Blank Panel with rearward extrusion for mounting components.
- 5F4 Filler Panel, L.H. Side, $5\frac{1}{4}$ " high x $\frac{1}{2}$ " wide
- 5F3 Filler Panel, R.H. Side, $5\frac{1}{4}$ " high
- B-11624 Side Mounting Bracket, $5\frac{1}{4}$ " high, for right or left side.
- 511 Power In and Out Panel - contains AC line cord, on-off switch, fuse, indicator light, binding posts for plus 16 vdc, minus 16 vdc, and ground.

<u>CDI Part No.</u>	<u>Description</u>
561	<u>Power Supply Module</u> - supports power supply transformer. To the rear is the regulated power section. Output is plus and minus 16 vdc for amplifiers, plus and minus 18 vdc for relays, and 6.3 vac for chopper drive.
561-M	Same as 561 except in addition has 3 $\frac{1}{2}$ " flat panel dc zero-center voltmeter, meter scale selection switch and scaling resistors. Pointer is nylon, and otherwise protected so that meter cannot be damaged by overload from any source in the panel of the computer. Contains VM jacks for external connection to meter.
522	<u>Mode Switch, Hold Switch and Amplifier Selector Switch Panel</u> - contains switch for the following modes of computer operation - Set, Run, Repetitive Operation, Graph Plot, Balance, Slave. Contains switch for Hold, Run. Contains 16-position switch to select amplifier outputs for reading on meter and for switching to Signal Readout Panel (Panel 512).
512	<u>Signal Readout Panel</u> - contains two pairs of banana jacks and one pair of pinjacks, each pair with one side grounded and one side connected to the amplifier output selected by the amplifier output selector switch on panel 522.
523	<u>Repetitive Operation and Graph-Plot Module</u> - contains switch for selecting computing times in repetitive operation mode. Contains "sync" output jack to trigger oscilloscope sweep for repetitive operation. Contains counters to indicate points from 1 to 99 in Graph-Plot mode. Contains pulsers for relay switching in Repetitive mode and for Graph-Plot mode.
521	<u>Precision Reference Voltage and Meter Function Switch Module</u> Contains jack for Plus Reference out, jack for Minus Reference out, Precision 10-turn wire-wound Reference Pot and turns counting dial, switch for connecting plus or minus Reference to the top of the Reference Pot and to the top of all grounded pots in type 321 Pot Panels. Contains precision voltage regulator for Plus and Minus (10,000 vdc) Reference. Contains switch for connecting meter to perform the following functions: <u>Pot Readout</u> (used in conjunction with pushbuttons in type 321 Attenuator Panel and Reference Pot to null the meter), <u>Null</u> (to null external voltages against Reference Pot), <u>Amplifier Readout</u> (to read output voltage of amplifier selected by switch in type 522 panel), <u>VM</u> (to read voltages fed into VM jacks in 561-M Power Supply Module).
524	<u>Slave Panel</u> - Contains switch for slaving an external computer to the computer or for slaving the computer to an external computer. Contains female connector for attaching interconnecting slaving cable. (Does not include power connection).

STANDARD RECOMMENDED CONFIGURATIONS OF THE PORTALOG COMPACT COMPUTER

The computer case accommodates several rows of computing modules. Referring to CDI Dwg. C-11659, Row A across the bottom accommodates $5\frac{1}{4}$ " modules and panels. Rows B, C, and D accommodate $3\frac{1}{2}$ " modules and panels. A maximum of four Model 2010-2 or 2010-1 amplifiers may be mounted behind the panels in any of the B, C, or D rows, in special housings.

OPTION I - 6 AMPLIFIER LINEAR COMPUTER

Option I of the computer contains six Model 2010-1 differential amplifiers. Rows A, B, and C are active, and Row D is left blank for future expansion. Rows B and C each contain three amplifiers plus desirable panels and modules for maximum usefulness as a computer. The panel components and modules of Option I are as follows (from left to right):

<u>Row A - Control Components</u>		<u>Position</u>
5F4	Filler Panel	Left
511	Power In and Out Panel	1
561-M	Power Supply Module with Meter	2 - 7
521	Precision Reference Pot & Meter Function Switch Module	8, 9
522	Mode Switch, Hold Switch, and Amplifier Selector Switch Panel	10, 11
520	Blank Panel	12, 13
520	Blank Panel	14, 15
512	Signal Readout Panel	16
5F3	Filler Panel	Right
<u>Row B - Amplifiers and Programming Components</u>		<u>Position</u>
3 Model 2010-1 Differential Amplifiers		Behind Panels
3F4-OL	Filler Panel with Overload Indicator Lights	Left
321	Attenuator Panel	1, 2
322	Summer Module	3, 4
311	Amplifier Module	5
323	Integrator-Summer Module	6, 7
311	Amplifier Module	8
324	Reference, Diode, and Tie Point Panel	9, 10
313	Dual Function Switch Panel	11
321	Attenuator Panel	12, 13
322	Summer Module	14, 15
311	Amplifier Module	16
3F3	Filler Panel	Right

Row C - Amplifiers and Programming Components

Identical to Row B except that type 312 Tie Point Panel is used in place of type 313 Dual Function Switch Panel in position 11.

Row D - (A blank panel is used in Option I.)OPTION II - 6 AMPLIFIER LINEAR COMPUTER

Option II of the computer is identical to Option I except that two Model 2010-2 chopper-stabilized amplifiers are used for the integrator summers instead of two Model 2010-1 differential amplifiers.

OPTION III - 6 AMPLIFIER LINEAR COMPUTER

Option III is identical to Option II except that the type 523 Repetitive Operation and Graph-Plot Module is used in place of the type 520 blank panel in positions 12 and 13.

OPTION IV - 10 AMPLIFIER LINEAR COMPUTER

Option IV is identical to Option III except that Row D is added instead of the blank 3½" panel. Row D consists of the following:

<u>Row D - Amplifiers and Programming Components</u>		<u>Position</u>
2 Model 2010-1 Differential Amplifiers and 2 Model 2010-2 Chopper-Stabilized Amplifiers		Behind Panels
3F4-OL	Filler Panel with Overload Indicator Lights	Left
321	Attenuator Panel	1, 2
322	Summer Module	3, 4
311	Amplifier Module	5
323	Integrator-Summer Module	6, 7
311	Amplifier Module	8
323	Integrator-Summer Module	9, 10
311	Amplifier Module	11
321	Attenuator Panel	12, 13
322	Summer Module	14, 15
311	Amplifier Module	16
3F3	Filler Panel	Right

OPTION V - 10 AMPLIFIER LINEAR COMPUTER
WITH 0.1% ACCURACY

Option V is identical to Option IV except that in Option V, all amplifiers are Model 2010-2 chopper-stabilized amplifiers, all six summer modules are type 322-P Precision Summer modules, and all four integrator-summer modules are type 323-P Precision Integrator-Summer modules.

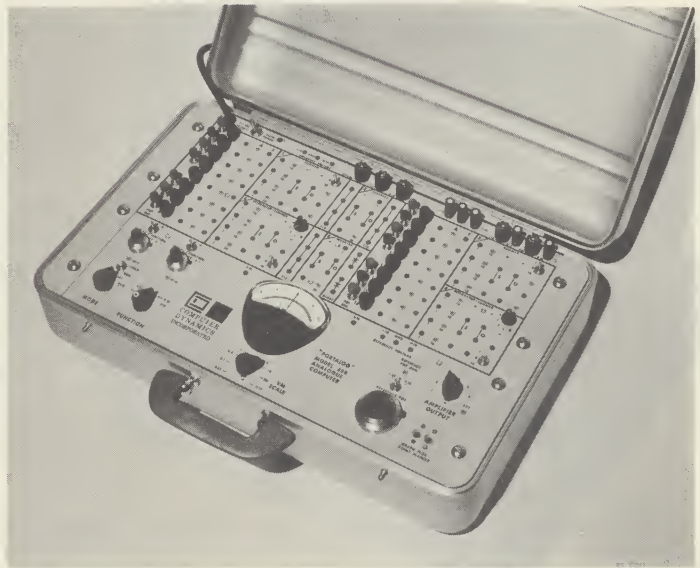


COMPUTER
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SPECIFICATION NO. 140
"PORTALOG" MODEL 600
COMPACT ANALOG COMPUTER

FEATURES:

- ALL SOLID-STATE
- MOST COMPACT AVAILABLE
- NEW "GRAPH-PLOT" MODE
ELIMINATES NEED FOR
EXTERNAL PLOTTER
- FULLY SELF-CONTAINED
- EXPANDABLE
- "REAL" TIME MODE
- "SLOW" TIME MODE
- REPETITIVE MODE



The "Portalog" Model 600 Compact Computer is a six-amplifier, fully-transistorized ± 10 volt analog computer designed for convenience. It may be hand-carried anywhere in its rugged, rain-proof aluminum attache' case, and is ready to operate immediately after connection to any standard 117 volt 50/60 cycle AC outlet. It may also be removed from its case and mounted in a standard relay rack of 19" width. It may be operated in tandem with another ± 10 volt computer or may be expanded by adding additional components in a rack installation. The amplifiers may be used conveniently as part of special instrumentation set-ups instead of as a computer.

The programming of the computer is on a conventional basis. It has all the control features of much larger computers, making it an ideal unit for instruction in the principles and applications of analog computers. A major feature is a new "Graph-Plot" mode of operation furnishing data in a most convenient form for recording problem solutions on graph paper and making unnecessary the use of any external recorder with the computer. Points are simply read off on the built-in meter at regular periodic intervals and are identified by an automatic counter. An external x-y plotter or oscilloscope may be used with the computer if desired.

No external plug-in resistors or capacitors are required to program the computer. Amplifier inputs and outputs are available so that special functions can be set up by means of patch cords. Input resistors and feedback resistors and capacitors are mounted internally. Feedback resistors and capacitors are selected simply by means of switches. All attenuators may be monitored without disturbing the patching by means of push-button switches which connect them to a "Pot Bus" which can be either read out on the meter or nulled against a precise reference potentiometer.

Repetitive operation with variable compatible initial conditions is another major feature of the "Portalog". Operation may be switched over to "Rep-Op" merely by switching in smaller feedback capacitors in the integrators.

179 Water Street, Torrington, Connecticut, U. S. A. 06791 Tel. [203] 482-7621

"IPAC" INDUSTRIAL PROCESS ANALOGIC COMPUTERS

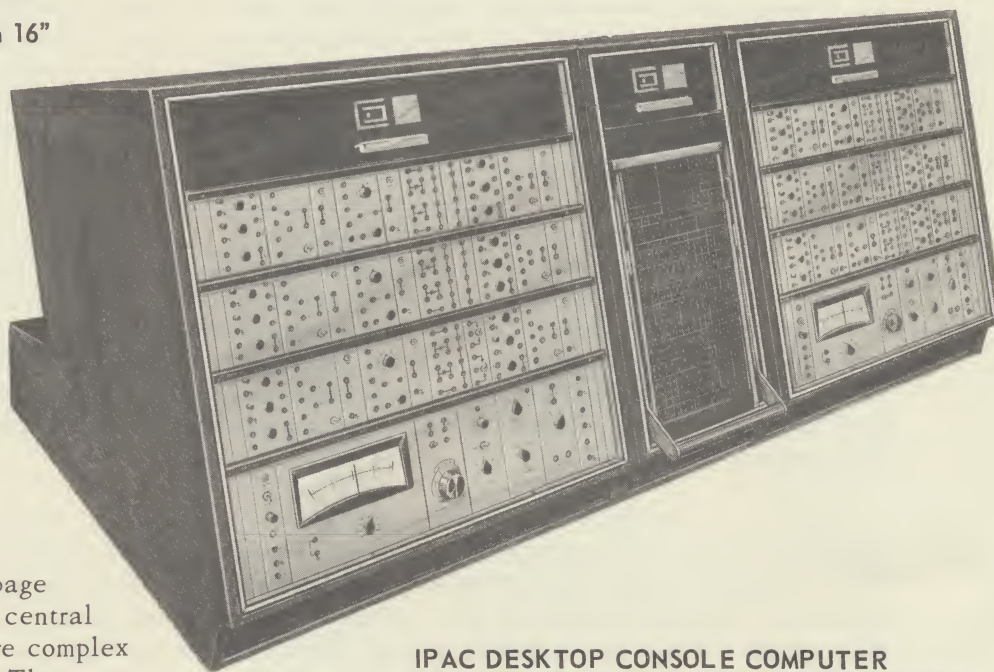


The designer of controls for industrial processes may simulate all or part of a process or its controls on a Portalog 600A (*See CDI Specification 200*) which is an evolution of the Portalog 600 into modular form. "The Portalog 600A may be expanded into a ten-amplifier general purpose linear computer, all still contained in a compact rugged case, weighing about thirty pounds complete. The same modular components may be assembled into the console shown at the left.

IPAC DESKTOP CONSOLE COMPUTER

Expandable to 14 amplifiers

Height 24", Width 21", Depth 16"



IPAC DESKTOP CONSOLE COMPUTER WITH 680 HOLE REMOVABLE PATCHBOARD

Expandable to 28 amplifiers by adding the additional console to the right of the patchbay.

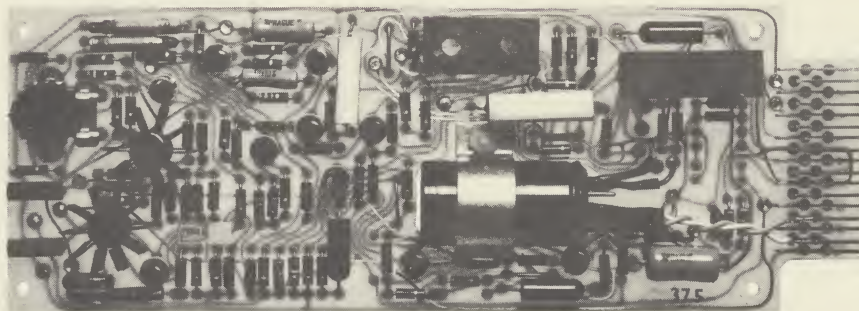
The consoles shown on this page lend themselves admirably to central computer facilities where more complex problems may be programmed. The removable patchbay adds flexibility with great economy.
See CDI Specification 200 for details.



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SPECIFICATION NO. 170
MODELS 2010-2, 2010-1- ± 10 VDC
SOLID STATE DC OPERATIONAL AMPLIFIERS

179 Water Street, Torrington, Connecticut, U.S.A. 06791 Tel. (203) 482-7621



Model 2010-2

FEATURES

1.5 MC BANDWIDTH

± 10 V OUTPUT SWING

OUTPUT CURRENT
 ± 30 ma

15 KC FULL OUTPUT CAPABILITY

SINGLE-ENDED INPUT AND OUTPUT
(Model 2010-2)

CHOPPER STABILIZED (Mech. Chopper)
(Model 2010-2)

FITS CDI "IPAC" MODULES
(Industrial Process Analog Computer)

HIGH GAIN (10^7 at DC) (Model 2010-2)
200,000 at DC (Model 2010-1)

LOW NOISE (See Detail Spec.)

INTERNAL OFFSET ADJUST

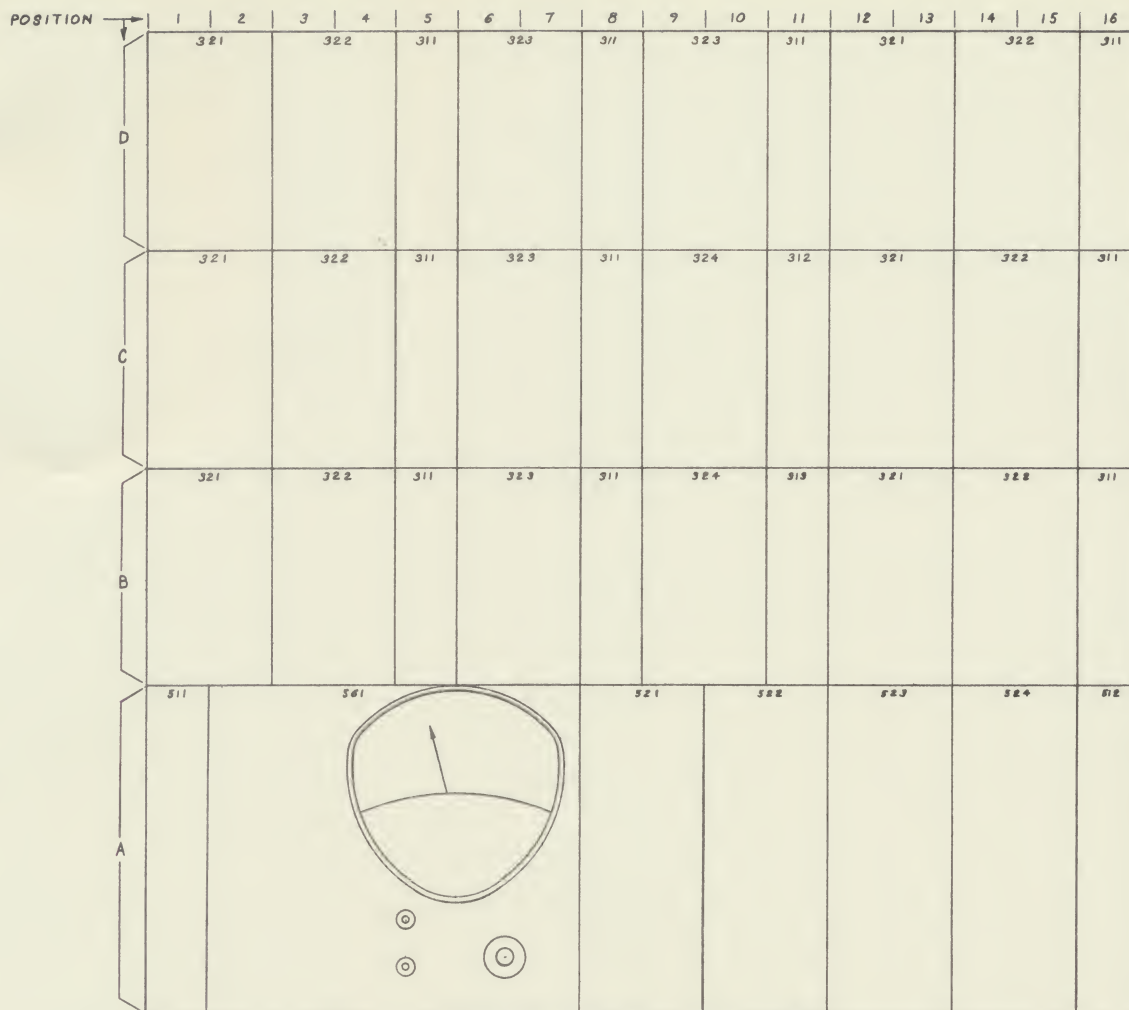
OUTPUT TOLERATES INDEFINITE SHORT
CIRCUIT TO GROUND

LOW COST (See Price List)

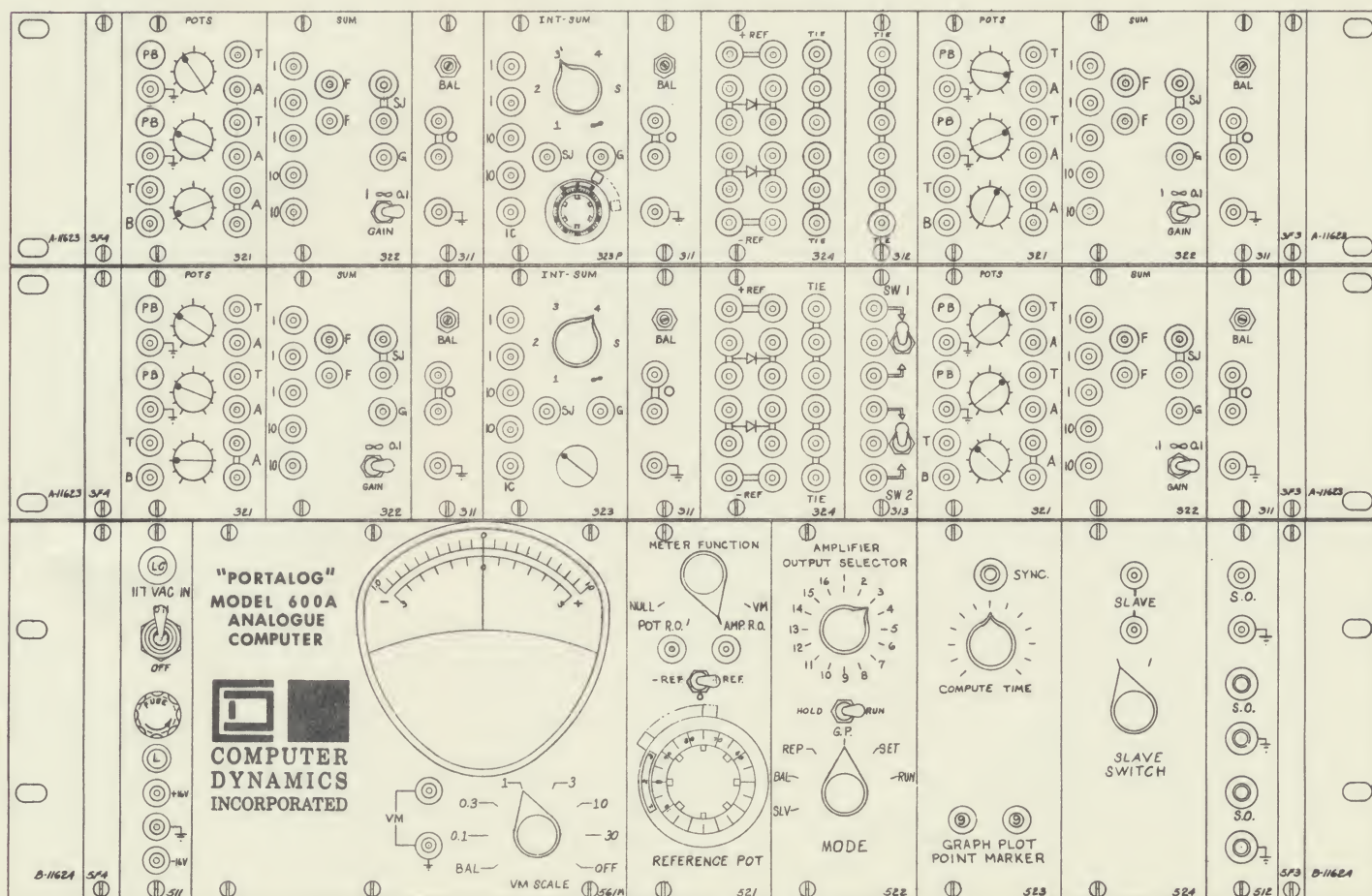
Ideal for general-purpose instrumentation, integration, or summation, Model 2010-2 is a chopper-stabilized plug-in solid state operational dc amplifier designed for analog computer systems. The Model 2010-2 represents a breakthrough in design for high performance and low cost. Full ± 30 ma output capability is maintained from 0 to 15KC, rolloff is 6 db per octave, input impedance is 1 megohm, gain bandwidth is 1.5 megacycles, and gain is 140 db min. at DC. Narrow band noise (0-50 cps) is only 50 microvolts peak-to-peak, and can be reduced to 20 microvolts p-p at slight extra cost upon specification. The high input impedance allows substantial cost savings for integrators, for a one-second integration time constant (1 volt/sec./volt) may be obtained with a 1 megohm input resistor and only a 1 mfd. feedback capacitor. Also available unstabilized as full differential input, single-ended output (Model 2010-1).

MODELS 2010-2, 2010-1 OPERATIONAL AMPLIFIERS

CHARACTERISTIC APPLICATIONS	Analog systems, Instruments, CDI "IPAC"
PRICE	Highly competitive (See Price List)
DELIVERY	Stock to six weeks
DIMENSIONS	2.75 x .675 x 7.50 inches (Mount on 1 inch centers in CDI "IPAC" modules)
INSTALLATION DRAWING	CDI Dwg. No. B-11628
CONNECTIONS	17-Contact Varicon; Mates with Elco 7001 Series
OUTPUT VOLTAGE	$\pm 20V$
OUTPUT CURRENT	$\pm 30ma$
POWER SUPPLY REQUIREMENT	± 16 VDC at 15ma plus load current 6.3VAC at 33 ma (for chopper drive)
CHOPPER	Mechanical 50/60 cps or 400 cps
MAX. FREQ. FOR $\pm 10V$ SWING INTO 1K LOAD	15KC
LOWEST LOAD RESISTANCE WITHOUT DEGRADING SPEC'S	1K
MAX. OUTPUT VOLTAGE SWING RATE	2×10^6 Volts/sec.
OPEN LOOP OUTPUT IMPEDANCE	150 ohms at DC
FREQ. OF UNITY OPEN LOOP GAIN	1.5mc
ROLLOFF TO BELOW UNITY GAIN	6 db/octave (optimum for systems)
DC GAIN	140 db (10^7) (Model 2010-2)
INPUT IMPEDANCE	1 megohm (Model 2010-2) 200 K (Model 2010-1)
DRIFT ($0^\circ C$ to $50^\circ C$)	± 100 microvolts (long-term)
TYPICAL DRIFT AS INTEGRATOR (1 Sec)	200 microvolts/minute at constant temp.
OFFSET ADJUSTMENT SENSITIVITY	100 microvolts/volt at REF. input ± 100 microvolts via internal trimmer
DC INPUT CURRENT	10^{-11} amp
OFFSET SENSITIVITY TO SUPPLY VOLTAGE	10 microvolts/volt
VOLTAGE NOISE REFERRED TO INPUT	0-50 cps: 50 μv p-p (20 μv p-p available) 0-10KC: 100 μv p-p



CDI DRAWING #C-11659



CDI DRAWING #C-11622